DOCUMENT RESUME

ED 153 582 HE 009 906

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TITLE Level of Adjunct Question, Type of Feedback and Learning Concepts from Prose.
PUB DATE 78
NOTE 16p.

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Cognitive Style; College Instruction; College Students; Concept Teaching; *Feedback; Higher Education; *Learning Processes; *Prose
IDENTIFIERS Iowa State University Ames; *Prose Learning

ABSTRACT

The effects of level of adjunct question (factual, application) and type of feedback (no feedback, correct answer feedback, self-correction feedback) on learning concepts from prose were examined in a study of 135 volunteer undergraduates at Iowa State University. Adjunct application questions produce better performance on subsequent new application items. This result supported the conclusion that practicing application while studying facilitates later use of the concept. Feedback influenced performance on the question asked during instruction, but not on new factual or application questions. These results suggested that college students need training in using feedback to learn concepts. (Author)

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ED153582

Level of Adjunct Question, Type of Feedback and Learning Concepts from Prose

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Running head: Questions, feedback and learning

CE 009 906

Abstract

The effects of level of adjunct question (factual, application) and type of feedback (no feedback, correct answer feedback, self-correction feedback) on learning concepts from prose were examined. Adjunct application questions produced better performance on subsequent new application items. This result supported the conclusion that practicing application while studying facilities later use of the concept. Feedback influenced performance on the questions asked during instruction, but not on new factual or application questions. These results suggested that college students need training in using feedback to learn concepts.

Level of Adjunct Question, Type of Feedback and Learning Concepts from Prose

Educators generally believe that asking higher level questions of students during instruction facilitates learning, retention, and the development of thinking skills. A number of reviewers have indicated that empirical support for this belief is weak (Andre, Note 1; Anderson and Biddle, 1975; Dunkin and Biddle, 1974). Moreover, little is known about the conditions under which question level influences instruction. Some studies (Watts & Anderson, 1971; Dapra & Felker, 1975) have apparently demonstrated beneficial effects for higher level questions; while other studies (Anderson & Biddle, 1975; Andre, 1976) have found superior performance for low level questions. Andre and Sola (1976) argued that question level might interact with feedback and the opportunity to restudy the instructional material. Their study demonstrated that subjects who received higher level test items and who also had the opportunity to restudy did better on a final test containing new higher level items. Subjects who received high level items but did not have the opportunity to restudy did no better than subjects who received low level test items. Andre and Sola (1976) argued that test item level influenced learning most positively when combined with feedback and the opportunity to restudy.

While the results of the Andre and Sola (1976) study are suggestive, certain facts raise questions about the generalizability of their findings. The materials consisted of an arbitrary list of sentences and subjects merely had to memorize the subject nouns. Similar results may not occur when connected text is used as the instructional medium and the intent is to teach concepts. The purpose of the present study was to examine the effect of question level, feedback, and the opportunity to restudy in the context of learning concepts.

Watts and Anderson (1971) developed an interesting methodology for examining

the effects of question level on concept learning. Subjects read passages which explained psychological concepts and were asked either to answer factual or application adjunct questions while studying. On the posttest, students faced new application questions. The Watts and Anderson (1971) materials involved psychological concepts, as did the Felker and Dapra (1975) study which used similar procedures and also found a beneficial effect of higher level questions. We employed the basic Watts and Anderson (1971) procedure, but used logical concepts in an economic context to extend the nature of the subject matter.

In the present study, students read a short passage explaining fallacies of logic and answered either factual or application adjunct questions immediately after reading the passage. One day later subjects either were or were not given feedback on their test performance and were allowed to reread the passage. Subjects then took a test containing items testing new applications of the described fallacies. It was hypothesized that subjects who received higher level questions and subjects who received feedback would perform better than subjects who did not. In addition, we predicted that the combination of higher level question and feedback would be superior to either of the variables singly (a question level by feedback condition interaction).

Method

Subjects. The subjects were 135 volunteers from introductory psychology classes at Iowa State University; extra course credit was allowed for participating.

Design. A three (Type of question) X three (Type of feedback) ANOVA represents the design. Subjects received either Factual or Application or Both types of adjunct questions immediately after reading the instructional passage. One day later subjects were given either: No Feedback, the correct answer to the adjunct questions (Correct Answer Feedback), or a list of items gotten wrong and right, the instructional

passage and instructions to find the correct answers to items gotten wrong (Self-Correction Feedback). There were nine groups formed by the combinations of the levels of the 2 factors.

Materials. A 600 word text explaining six common fallacies of logic and using economic examples to clarify these concepts constituted the passage. For each fallacy, three application and three factual questions were written. Application questions asked students to select an example of the fallacy from among four alternatives: factual questions asked students to select the correct verbatim ending of a text sentence from among 4 alternatives. Six of the factual and application questions were used to construct adjunct questions that were given immediately after the passage. There were three versions of these adjunct questions tests: a 6 item factual version, a 6 item application version, and a 12 item combined version. The adjunct questions were combined with the remaining factual and application items to construct a final posttest. From this posttest four scores were derived for each subject: performance on repeated factual, repeated application, new factual and new application questions. In order to control for question specific effects, the total set of 18 factual and 18 application questions were each divided into 3 subsets of 6 items each. Use of these subsets as adjunct items was counterbalanced within each of the nine treatment combinations.

The procedure for counterbalancing was tedious but simple. The 18 Factual and 18 Application items were each divided into 3 sets of 6 which may be labeled sets A, B and C. The A, B, and C sets of Factual and Application items each served as adjunct items for about one-third of the subjects in their appropriate conditions. For the mixed condition, the A, B and C set of Factual and Application items were paired to make 3 sets of 12 items which may be labeled sets AA, BB and CC. Order of items within the adjunct items tests was independently randomized for each set.

In scoring the posttest the parallel between the A, B and C sets of Factual and Application items was maintained. For example, for subjects who received the A set of Factual items as adjunct questions, the A set Application items were counted as Repeated Application items and so on.

Procedure. The study was run in a typical college classroom. Prior to the first session of the experiment, booklets coded for each of the nine treatment combinations had been unsystematically intermixed. Subjects were assigned to conditions by distributing the booklets in that random order. In the first session, subjects read the instructional passage at their own pace. When done, subjects raised their hands, the experimenter retrieved the passage booklet and gave the subjects the appropriate adjunct questions. Subjects were not permitted to review the passage to answer the adjunct questions. One day later, subjects returned and were given feedback appropriate to their condition. Subjects in the Self-Correction conditions were told which items they got wrong and reread the passages to discover correct answers to those items. These subjects indicated their choice of new correct answer while doing so. Subjects in the Correct Answer conditions were given the correct answers to all items and were told to reread the passage and pay close attention to material related to items gotten wrong. Subjects in the No Feedback conditions were given no information about test performance and were simply given the passage to reread. Subjects had as long as they wished to complete the rereading; when done, all subjects took the 36 item posttest.

Results

Table 1 contains the mean arcsine transformed percent correct on the adjunct questions and the mean number of items correct for each of the four types of posttest scores. Separate 3 X 3 analyses of variance were computed for each of these five types of scores. Since the number of subjects differed between conditions, an un-

weighted mean solution was used. The major purpose of the study was to determine the effects of Type of Question and Types of Feedback on learning concepts, therefore, performance on the new application questions represents the variable of main interest. Performance on each of the variables is discussed in turn.

Adjunct Items. Since there were different numbers of items for the mixed, factual and application groups, the arcsine transformed percent correct served as the measure of performance. Only the effect of Type of Question proved significant, F (2, 126) = 3.513, $p < .032$, MS error = .0836. The means were: Factual = 1.088, Application = 1.098, Both = 0.952. Basically, the factual and application groups outperformed the groups receiving both types of items.

New Application. Only the effect of Type of Question proved significant, F (2, 126) = 3.858, $p < .024$, MS error = 5.164. The means were: Factual = 8.438, Application = 9.512, Both = 8.280. Both the Application - Factual and Application - Both group differences were significant when tested by the Newman-Keuls procedure. Basically, the groups receiving only adjunct application questions did better on new applications of the presented concepts than did the other groups.

New Factual. None of the differences between any of the conditions proved significant for the New Factual items. The means for each condition are given in Table 1.

Repeated Application. Only the main effect of Type of Question proved significant, F (2, 126) = 4.384, $p < .0144$, MS error = 1.336. The means were: Factual = 4.268, Application = 4.993, Both = 4.678. Only the difference between the Application and Factual groups proved significant when tested by the Newman-Keuls procedure.

Repeated Factual. Only the main effect of Type of Question proved significant, F (2, 126) = 5.551, $p < .00489$, MS error = 1.378. The means were: Factual = 4.762, Application = 4.202, Both = 5.014. The Factual and Both groups significantly out-

performed the Application group when tested by the Newman-Keuls procedure.

Type of Feedback did not prove significant in any analysis. However, the way in which the analyses were performed may have masked any effect of feedback. It may be that feedback has an effect only on the items for which it is given. In the analyses described above, it was never the case that all subjects were being tested on items that they had received previously. For example, in the analysis of repeated factual questions, only subjects in the Factual and Both conditions had received those questions previously; subjects in the Application conditions had not seen those items before. The fact that the items were truly repeated for some subjects and not for others may have masked any effect of feedback.

In addition, Phye (Note 2) had recommended that an analysis of the types of posttest errors be made when feedback is studied. Phye classified errors into repeated, different, and new errors. Repeated errors are choices of the same wrong alternatives originally chosen, different errors are choices of a different wrong alternative from the one chosen previously, and new errors are errors on items initially correct. Phye has argued that the analysis of such errors may reveal effects not found in an overall analysis.

For these two reasons, a 3 (Type of Question) X 3 (Type of Feedback) X 3 (Type of Error) unweighted means supplementary analysis was performed on the repeated items. Type of Error was a within subject factor. The dependent measure in this supplementary analysis consisted of the arcsine transformed percent of repeated, different, and new errors for subjects in each of the conditions. The denominator used in computing the percents was the number of adjunct items. Thus, for subjects in the Factual conditions, the percents of repeated, different, and new errors on Repeated Factual items were computed. For subjects in the Application conditions, the percents of repeated, different, and new errors on Repeated Application items were computed; for subjects in the Both conditions, repeated, different, and new

errors on both Repeated Factual and Application items were counted. The analysis revealed significant main effects for Type of Question and Type of Feedback, Fs (2, 126) = 6.423 and 3.353, ps < .002 and .038, respectively, MS error = 0.0152. The means were: Factual = 35.3, Application = 33.9, Both = 30.0; and No Feedback = 34.7, Correct Answer = 33.6, Self Correct = 30.9. Basically, the Both conditions did better than did the Factual or Application groups and the Self Correct conditions did better than the Correct Answer or No Feedback conditions.

Discussion

The major finding of this study was the beneficial effect of application questions on later application. Subjects given Application adjunct questions did better than subjects given Factual application questions. Moreover, the improvement occurred without any loss in learning incidental factual information as performance on New Factual items was not different. This finding confirmed the Watts and Anderson (1971) and Felker and Dapra (1975) results and extended those to a new subject matter. This finding apparently supports the educators belief that higher level questions facilitate higher level learning. However, the beneficial effects of adjunct application questions were obtained only when they were used in isolation; when combined with adjunct factual questions, poor performance occurred on new application items.

An explanation for the difference in the effect of adjunct questions when used singly and when used in combination with the factual questions was not immediately apparent. Some sort of interference occurs between the factual and application items. For example, the processing capacity devoted to answering the factual questions may reduce processing capacity available for doing whatever processing is necessary for committing the concepts to long term memory. The fact that performance on the adjunct items in the Both conditions was lower than in the Factual or Application conditions is consistent with this hypothesis. This hypothesis could be tested by

varying the position of the items. If the items were inserted in the passage rather than massed at the end, then the processing demands of the task should be lessened, and subjects in the Both conditions should do as well as subjects in the application condition. Whatever the explanation for the difference, it is clear that the conditions under which higher level questions will facilitate performance in practical educational situations are not well understood. Clearly, further research is necessary to delineate those conditions.

Part of the motivation for the present research was to determine if feedback would interact with level of question. Specifically, it was predicted that application questions would have greater benefit when combined with feedback. This prediction was not supported. Feedback did not influence performance on either new applications or new factual questions.

Feedback did have an effect on performance on repeated items. The effect was revealed in the supplementary analysis of repeated, different, and new errors. Subjects given feedback did better on the repeated items and the effect of feedback was greater if subjects corrected their previous answers. Importantly, these findings mean that the effect of feedback was specific to the question asked; subjects given feedback better learned to answer those specific questions. However, in the case of the application items, feedback did not help the subject learn the underlying concept even if the subject was forced to reanswer and reanswered correctly as most subjects did. If feedback had helped in the learning of the concept, then subjects given feedback should have done better on the New Application items, they did not.

The reason why feedback had only a question-specific effect may have to do with the nature of the learning task. In the Andre and Sola (1976) study, where feedback appeared to influence higher level learning, the materials consisted of

simple sentences and the higher level questions involved simple paraphrases of the sentences. With such materials, it seems likely that subjects who made an error on an initial item could use the feedback and restudy to properly re-encode the item. Understanding paraphrases is a highly overlearned task for most adults.

In the present study, the New Application questions involved recognizing new examples of presented fallacies, a much more complex task. It may have been the case that subjects who made an error had no idea of how to correct that original error even given the correct answer and the opportunity to restudy. The students may have simply been unable to take the presented verbal information and translate it into a procedure for recognizing new examples of the concepts. Larkin and Rief (1976) present evidence that many college students can lack such critical reading skills. This analysis suggests that, with complex cognitive tasks, feedback and restudy will not have a beneficial effect on learning unless the subject possesses prerequisite skills that allow use of the feedback.

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Table 1

Mean Performance on the Adjunct Questions and on the Four Types of Posttest Scores for Each of the Conditions

	TYPE OF SCORE				
	Adjunct Items[1]	Posttest Items			
		Repeated		New	
Condition	Arcsince Transformed Percent Correct	Factual	Application	Factual	Application
Factual-No Feedback	1.118	4.500	4.429	9.071	8.286
Factual-Correct Answer	1.024	4.786	4.000	8.429	8.214
Factual-Self Correct	1.112	5.000	4.375	9.062	8.812
Application-No Feedback	1.150	4.500	4.786	9.142	9.857
Application-Correct Answer	1.100	4.250	5.050	8.450	9.250
Application-Self Correct	1.044	3.857	5.143	7.929	9.423
Both-No Feedback	0.984	4.846	4.461	7.923	7.384
Both-Correct Answer	0.909	3.625	4.500	7.687	8.312
Both-Self Correct	0.964	5.571	5.071	8.214	9.143

[1]Since the Mixed groups received 12 and the Factual and Application groups received 6 adjunct items, performance was represented as the percent correct. The percents were subjected to the arcsine transformation for the analysis of variance. For posttest scores the number of items for each type was the same across conditions, so the number of items correct are reported. For the Repeated questions the maximum score is 6, for the New Items the maximum is 12.